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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/469,652	12/22/1999	JONATHAN J. WIERER JR.	10992873-1	5235

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EXAMINER	
CHU, CHRIS C	

ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 05/07/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/469,652	WIERER ET AL.	
	Examiner	Art Unit	
	Chris C. Chu	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 February 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1, 3, 5 - 11 and 14 - 20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 3, 5 - 11 and 14 - 20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Response to Amendment

1. Applicant's amendment filed on February 4, 2003 has been received and entered in the case.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1, 8, 10 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. in view of Hunt et al., and further in view of Ishikawa et al.

Regarding claim 1, Biing-Jye et al. discloses in Fig. 2A and column 3, lines 22 ~ 24 a light emitting device comprising:

- a semiconductor heterostructure (InGaN) including at least one p-type layer (p-GaN) and one n-type layer (n-GaN); and
- a p contact (p-ohmic) and an n contact (n-ohmic), the p contact electrically connected to the p-type layer, the n contact electrically connected to the n-type layer, wherein at

least one of the p (p-ohmic) and n contacts is a multi-layer contact external to the semiconductor heterostructure, the multi-layered contact comprising:

- a metallic reflector layer;
- a continuous uniform conducting sheet that makes ohmic contact to the heterostructure (p-GaN).

Biing-Jye et al. does not disclose the multi-layer contact having a reflectivity greater than 75% for light at an operating wavelength of the light-emitting device. Hunt et al. discloses in Fig. 1 and column 2, line 67 ~ column 3, line 2 a multi-layer contact having a reflectivity greater than 75% for light at an operating wavelength of a light-emitting device. Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to modify Biing-Jye et al. by using the reflectivity to be greater than 75% as taught by Hunt et al. The ordinary artisan would have been motivated to modify Biing-Jye et al. in the manner described above for at least the purpose of enhancing efficiencies (column 1, lines 57 ~ 60).

Biing-Jye et al. and Hunt et al. do not disclose a conductive barrier layer. However, Ishikawa et al. discloses in Fig. 7, column 9, lines 45 ~ 67 and column 11, lines 21 ~ 24 a conductive barrier layer (128) interposing a reflector layer (127) and a continuous uniform conducting sheet (129). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to modify Biing-Jye et al. by using the conductive barrier layer as taught by Ishikawa et al. The ordinary artisan would have been motivated to modify Biing-Jye et al. in the manner described above for at least the purpose of providing the voltage drop between the electrodes (column 10, lines 30 ~ 37).

Regarding claim 8, Biing-Jye et al. discloses in Fig. 2A the p and n contacts being on opposing faces of the heterostructure.

Regarding claim 10, Hunt et al. discloses in column 3, lines 1 ~ 3 the reflector layer being Ag.

Regarding claim 19, Biing-Jye et al. discloses in Fig. 2A the semiconductor heterostructure including at least one III-nitride layer.

4. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al., Hunt et al. and Ishikawa et al. as applied to claim 1 above, and further in view of Sugiura et al.

Biing-Jye et al. and Hunt et al. do not disclose the contact resistance of the multi-layer contact of the light-emitting device, which is less than 0.01 Ω-cm^2. However, Sugiura et al. discloses in column 5, lines 27 – 32 a contact resistance of a multi-layer contact having less than 0.01 Ω-cm^2. It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to use the contact resistance which is less than 0.01 Ω-cm^2 of Sugiura et al. in the light-emitting device of Biing-Jye et al., Hunt et al. and Ishikawa et al. in order to improve ohmic contact as taught by Sugiura et al. in column 5, lines 26 ~ 28.

5. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al., Hunt et al. and Ishikawa et al. as applied to claim 1 above, and further in view of Nakagawa et al.

Biing-Jye et al., Hunt et al. and Ishikawa et al. disclose the claimed invention except the thickness of the reflector layer, which is greater than 500 angstroms. However, Nakagawa et al. discloses a thickness of a reflector layer to be "(Ti/Pd/Ag (400nm/200nm/1μm thick))" (column

19, lines 45 – 48). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to further modify Biing-Jye et al. by using the thickness of the reflector layer to be greater than 500 angstroms. The ordinary artisan would have been motivated to further modify Biing-Jye et al. in the manner described above for at least the purpose of increasing the reflection and to have a high quality semiconductor layer (column 19, line 57 – 59).

6. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al., Hunt et al. and Ishikawa et al. as applied to claim 1 above, and further in view of Liu et al.

Biing-Jye et al., Hunt et al. and Ishikawa et al. disclose all of the claimed invention except the thickness of the sheet that makes ohmic contact, which is less than 200 angstroms. However, Liu et al. discloses a thickness of a sheet that makes ohmic contact, which is less than 200 angstroms (column 4, lines 60 – 63). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to further modify Biing-Jye et al. by using the thickness of the sheet to be less than 200 angstroms as taught by Liu et al. The ordinary artisan would have been motivated to further modify Biing-Jye et al. in the manner described above for at least the purpose of improving the transistor performances (column 2, lines 43 ~ 46).

7. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al., Hunt et al. and Ishikawa et al. as applied to claim 1 above, and further in view of Schetzina.

Biing-Jye et al., Hunt et al. and Ishikawa et al. do not disclose the reflector layer being selected from a group that includes Al, Cu, Rh, Pd, and Au. Schetzina discloses in column 18,

lines 48 ~ 50 a reflector layer being selected from a group that includes Al, Cu, Rh, Pd, and Au. It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to select from the group that includes Al, Cu, Rh, Pd, and Au of Schetzina as the reflector layer in the light-emitting device of Biing-Jye et al., Hunt et al. and Ishikawa et al. in order to provide an optically reflecting metal ohmic contact as taught by Schetzina in column 18, lines 48 ~ 53.

8. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al., Hunt et al. and Ishikawa et al. as applied to claims 1 and 8 above, and further in view of Haitz et al.

Biing-Jye et al., Hunt et al. and Ishikawa et al. do not disclose the sheet that makes ohmic contact to the heterostructure includes Ni and Ag. However, Haitz et al. discloses in column 3, lines 31 ~ 34 a sheet that makes ohmic contact to a heterostructure includes Ni and Ag. It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to use Ni and Ag of Haitz et al. for the sheet in the light-emitting device of Biing-Jye et al., Hunt et al. and Ishikawa et al. in order to improve reflectivity as taught by Haitz et al. in column 3, line 32.

9. Claims 11, 14 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. in view of Hunt et al., and further in view of Sugiura et al.

Regarding claim 11, Biing-Jye et al. discloses in Fig. 2A and column 3, lines 22 ~ 24 a light-emitting semiconductor device comprising:

- a semiconductor heterostructure (GaN) having at least one p-type layer (p-GaN) and one n-type layer (n-GaN); and
- a p contact (p-ohmic) and an n contact (n-ohmic), the p contact electrically connected to the p-type layer, the n contact electrically connected to the n-type layer, wherein at least one of the p and n contacts is a multi-layer contact external to the semiconductor heterostructure,
    - a metallic reflector layer; and
    - a continuous uniform conducting sheet that makes ohmic contact to the heterostructure.

Biing-Jye et al. does not disclose the multi-layer contact having a reflectivity greater than 75% for light at an operating wavelength of the light-emitting device. Hunt et al. discloses in Fig. 1 and column 3, lines 16 ~ 28 a multi-layer contact having a reflectivity greater than 75% for light at an operating wavelength of a light-emitting device. Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to modify Biing-Jye et al. by using the reflectivity to be greater than 75% as taught by Hunt et al. The ordinary artisan would have been motivated to modify Biing-Jye et al. in the manner described above for at least the purpose of enhancing efficiencies (column 1, lines 57 ~ 60).

Biing-Jye et al. and Hunt et al. do not disclose the contact resistance of the multi-layer contact of the light-emitting device, which is less than 0.01 Ω-cm^2. However, Sugiura et al. discloses in column 5, lines 27 ~ 32 a contact resistance of a multi-layer contact having less than 0.01 Ω-cm^2. It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to use the contact resistance which is less than 0.01 Ω-cm^2 of

Sugiura et al. in the light-emitting device of Biing-Jye et al. and Hunt et al. in order to improve ohmic contact as taught by Sugiura et al. in column 5, lines 26 ~ 28.

Regarding claim 14, Hunt et al. discloses in column 2, lines 63 ~ 66 the multi-layer contact further comprising a barrier layer interposing the reflector layer and the sheet.

Regarding claim 20, Biing-Jye et al. discloses in Fig. 2A the semiconductor heterostructure including at least one III-nitride layer.

10. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al., Hunt et al. and Sugiura et al. as applied to claim 11 above, and further in view of Nakagawa et al.

Biing-Jye et al., Hunt et al. and Sugiura et al. disclose the claimed invention except the thickness of the reflector layer, which is greater than 500 angstroms. However, Nakagawa et al. discloses a thickness of a reflector layer to be "(Ti/Pd/Ag (400nm/200nm/1μm thick))" (column 19, lines 45 – 48). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to further modify Biing-Jye et al. by using the thickness of the reflector layer to be greater than 500 angstroms. The ordinary artisan would have been motivated to further modify Biing-Jye et al. in the manner described above for at least the purpose of increasing the reflection and to have a high quality semiconductor layer (column 19, line 57 – 59).

11. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al., Hunt et al. and Sugiura et al. as applied to claim 11 above, and further in view of Liu et al.

Biing-Jye et al., Hunt et al. and Sugiura et al. disclose all of the claimed invention except the thickness of the sheet that makes ohmic contact, which is less than 200 angstroms. However, Liu et al. discloses a thickness of a sheet that makes ohmic contact, which is less than 200 angstroms (column 4, lines 60 – 63). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to further modify Biing-Jye et al. by using the thickness of the sheet to be less than 200 angstroms as taught by Liu et al. The ordinary artisan would have been motivated to further modify Biing-Jye et al. in the manner described above for at least the purpose of improving the transistor performances (column 2, lines 43 ~ 46).

12. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al., Hunt et al. and Sugiura et al. as applied to claim 11 above, and further in view of Schetzina.

Biing-Jye et al., Hunt et al. and Sugiura et al. do not disclose the reflector layer being selected from a group that includes Al, Cu, Rh, Pd, and Au. Schetzina discloses in column 18, lines 48 ~ 50 a reflector layer being selected from a group that includes Al, Cu, Rh, Pd, and Au. It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to select from the group that includes Al, Cu, Rh, Pd, and Au of Schetzina as the reflector layer in the light-emitting device of Biing-Jye et al., Hunt et al. and Sugiura et al. in order to provide an optically reflecting metal ohmic contact as taught by Schetzina in column 18, lines 48 ~ 53.

13. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al., Hunt et al. and Sugiura et al. as applied to claim 11 above, and further in view of Okazaki.

Biing-Jye et al., Hunt et al. and Sugiura et al. disclose the claimed invention except the material of an ohmic contact layer. However, Okazaki discloses that a material of an ohmic contact layer (13) being selected from a group of "titanium (Ti), nickel (Ni), etc." (column 8, lines 9 – 14 and column 8, lines 32 – 37). Therefore, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to further modify Biing-Jye et al. by selecting from the titanium (Ti) for the ohmic contact layer as taught by Okazaki. The ordinary artisan would have been motivated to further modify Biing-Jye et al. in the manner described above for at least the purpose of decreasing the ohmic contact resistance between the layers and increasing the reflectivity of the ohmic contact layer.

Response to Arguments

14. Applicant's arguments filed on February 4, 2003 have been fully considered but they are not persuasive.

On page 6, applicant argues "applicants can find no teaching in Sugiura of controlling the resistance between the layers of a multi-layer contact. If an additional layer were added to Sugiura's contact, the resistance could easily exceed the resistance taught by claim 11. Accordingly, even in combination, Biing-Jye, Hunt, and Sugiura do not teach all the elements of claim 11." This argument is not persuasive. Sugiura clearly discloses in column 20, lines 3 ~ 14 a multi-layer structure having a good ohmic contact which is about $7 * 10^{-3}$ Ωcm^2. Since Sugiura teaches a multi-layer contact that has a less than 0.01 Ω-cm^2, Biing-Jye, Hunt, and Sugiura teach all the elements of claim 11.

Further, applicant argues "applicants can find no teaching in Nakagawa that the 'collecting electrode' cited by the Examiner is reflective." This argument is not persuasive. Nakagawa discloses in column 14, lines 1 and 2 that silver also functions as a back-surface electrode and a back-surface reflection layer. Since silver is a part of the collecting electrode (Ti/Pd/Ag), the collecting electrode (Ti/Pd/Ag) is reflective. Note page 7, lines 27 and 28 of applicant's specification, which clearly indicates that Pd and Ag in the collecting electrode make "reflective." Therefore, Nakagawa teaches a reflector layer.

Furthermore, applicant argues "since it would not be obvious to use thicknesses taught for non-reflective electrode, a person of skill in the art would not be motivated to combine the thickness taught in Nakagawa with the electrode structures of Biing-Jye and Hunt" This argument is not persuasive. As explained in the above paragraph, since Nakagawa teaches a thickness of a reflector layer, a person of skill in the art would be motivated to combine the thickness taught in Nakagawa with the electrode structures of Biing-Jye and Hunt.

Finally, applicant argues "the passage quoted by the Examiner deals with the thickness of a semiconductor layer, not a multi-layer contact. Accordingly, the combination of Biing-Jye, Hunt, and Liu do not teach all the elements of claims 6 and 16." This argument is not persuasive. First, claims 6 and 16 do not claim a thickness of the multi-layer contact but a thickness of the sheet that makes ohmic contact. Second, Liu teaches in column 4, lines 60 ~ 63 a thickness of a sheet that makes ohmic contact as recited in the rejected claims 6 and 16. Thus, the combination

of Biing-Jye, Hunt, Ishikawa et al. and Liu teach all the elements of claim 6 and the combination of Biing-Jye, Hunt, Sugiura et al. and Liu teach all the elements of claim 16.

For the above reasons, the rejection is maintained.

Conclusion

15. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is (703) 305-6194. The examiner can normally be reached on M-F (10:30 - 7:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on (703) 308-1690. The fax phone numbers for the

organization where this application or proceeding is assigned are (703) 308-7382 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Chris C. Chu
Examiner
Art Unit 2815

c.c.
May 2, 2003

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